

WHAT IS CLAIMED IS:

1. A centrifugal blood pump apparatus comprising:
  - a housing having a fluid inlet port and a fluid outlet port;
  - a centrifugal pump section including an impeller having a first magnetic material therein and rotating inside said housing to feed a fluid by a centrifugal force generated during a rotation thereof;
  - an impeller rotational torque generation section for attracting and rotating said impeller; and
  - a hydrodynamic pressure groove formed at a portion of an inner surface of said housing at a rotor-disposed side or at a portion of a surface of said impeller at said rotor-disposed side,
  - said impeller rotating without contacting said housing owing to an action of said hydrodynamic groove,
  - said centrifugal blood pump apparatus further comprising:
- 15 an electromagnet for attracting said first magnetic material of said impeller or a second magnetic material provided on said impeller separately from said first magnetic material in a direction opposite to a direction in which said impeller rotational torque generation section attracts said first magnetic material and helping said impeller levitate.
- 20 2. A centrifugal blood pump apparatus according to claim 1, wherein said impeller rotational torque generation section has a rotor having a magnet for attracting said first magnetic material of said impeller and a motor for rotating said rotor; and said hydrodynamic pressure groove formed at the portion of an inner surface of said housing at a rotor-disposed side or the portion of a surface of said impeller at said rotor-disposed side, and said electromagnet for attracting said first magnetic material or a second magnetic material in a direction opposite to the direction in which said magnet of said rotor attracts said first magnetic material and helping said impeller levitate.
- 25 3. A centrifugal blood pump apparatus according to claim 2, wherein said first magnetic material of said impeller and said magnet of said rotor for

attracting said first magnetic material consist of a plurality of permanent magnets respectively; and said permanent magnets of said impeller and said permanent magnets of said rotor are arranged on a circumference respectively in such a way that said permanent magnets of said impeller and said permanent 5 magnets of said rotor have the same polarity respectively; and said permanent magnets of said impeller and said permanent magnets of said rotor are arranged on two different circumferences facing each other in such a way that a polarity of said permanent magnets of said impeller arranged on one of said two circumferences and a polarity of said permanent magnets of said rotor arranged 10 on the other of said two circumferences are opposite to each other.

4. A centrifugal blood pump apparatus according to claim 1, wherein said impeller rotational torque generation section has a plurality of stator coils, disposed circumferentially to rotate said impeller, for attracting said first magnetic material of said impeller of said centrifugal blood pump section; and 15 said hydrodynamic pressure groove formed at the portion of an inner surface of said housing at a stator coil-disposed side or at the portion of a surface of said impeller at said stator coil-disposed side thereof, and said electromagnet for attracting said first magnetic material or a second magnetic material in a direction opposite to the direction in which said stator coils attract said first 20 magnetic material and helping said impeller levitate.

5. A centrifugal blood pump apparatus according to claim 1, further comprising a control mechanism, for controlling said impeller rotational torque generation section and said electromagnet, having a function of changing a degree of an impeller-attracting force of said electromagnet according to a 25 rotation speed generated by said impeller rotational torque generation section.

6. A centrifugal blood pump apparatus according to claim 5, wherein said control mechanism has a function of keeping a distance between said impeller and said housing constant by changing a degree of an impeller-attracting force of said electromagnet according to a rotation speed generated by said impeller 30 rotational torque generation section.

7. A centrifugal blood pump apparatus according to claim 1, further comprising a control mechanism, for controlling said motor and said electromagnet, having a rotation start state control function of starting a rotation of said impeller rotational torque generation section with said electromagnet  
5 attracting said impeller thereto at a force not less than a predetermined value.

8. A centrifugal blood pump apparatus according to claim 1, further comprising a control mechanism, for controlling said motor and said electromagnet, having a rotation start state control function of starting a rotation of said impeller rotational torque generation section with said electromagnet  
10 attracting said impeller thereto at a force not less than a predetermined value; and a control function of reducing an attractive force of said electromagnet to a value less than said predetermined value after said impeller rotational torque generation section starts to rotate.

9. A centrifugal blood pump apparatus according to claim 5, wherein said  
15 control mechanism has a function of monitoring electric current of said impeller rotational torque generation section and controls said electromagnet by using an electric current value detected by said function of monitoring said electric current of said impeller rotational torque generation section.

10. A centrifugal blood pump apparatus according to claim 1, wherein a  
20 corner of said hydrodynamic pressure groove is chamfered to allow said corner to have a radius of rounding at not less than 0.05mm.

11. A centrifugal blood pump apparatus according to claim 1, wherein said  
25 centrifugal blood pump apparatus has a second hydrodynamic pressure groove formed at a portion of an inner surface of said housing at a electromagnet-disposed side or at a portion of a surface of said impeller at said electromagnet-disposed side.

12. A centrifugal blood pump apparatus according to claim 11, wherein a corner of said second hydrodynamic pressure groove is chamfered to allow said corner to have a radius of rounding at not less than 0.05mm.